

AD-A266 013

REPORT DOCUMENTATION PAGE

FORM APPROVED
GSA FPMR (41 CFR) 101-11.7
OMB NO. 0704-0183

(2)

This report was prepared in accordance with the provisions of the Freedom of Information Act. The purpose of this form is to provide information concerning the collection and reporting of data required by law. The information collected is used to evaluate the effectiveness of the collection of information and to improve the quality of information collected. The information is also used to support the Office of Management and Budget's responsibilities under the Paperwork Reduction Act.

AGENCY USE ONLY (Leave Blank) 2. REPORT DATE
6/3/93 3. REPORT TYPE AND DATES COVERED
Final Report

TITLE AND SUBTITLE
Studies of Electrostatic Waves and VLF-Wave Particle
Interaction in the Ionosphere

AUTHOR(S)
Paul M. Kintner

S. FUNDING NUMBERS
Contract Number
N00014-90-C-0003

PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Cornell University
Office of Sponsored Programs
123 Day Hall
Ithaca, NY 14853

3. PERFORMING ORGANIZATION
REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
The Office of Naval Research
Space Physics Program (Code 3142)
800 North Quincy Street
Arlington, VA 22217

10. SPONSORING MONITORING
AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
DTIC
S E L E C T E D
JUN 21 1993

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for Public Release:
Distribution is Unlimited.

12b. DISTRIBUTION CODE
Statement A

13. ABSTRACT (Maximum 200 words)

This is the final report for the contract N00014-90-C-0003. Under this contract a HF plasma wave receiver was delivered for the Swedish spacecraft Freja and subsequently launched in October, 1992. The receiver was designed to sense short wavelength intermittent plasma waves in the frequency range characterized by the electroplasma and gyrofrequency. The receiver is operating nominally and preliminary data analysis indicates the common occurrence of coherent and modulated Langmuir waves with amplitudes of several to greater than 20 mV/m.

93-13822

93 6 10 020

SP8

14. SUBJECT TERMS

plasma waves, Langmuir waves, ionosphere, aurora

4

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT
---	--	---	----------------------------

Final Technical Report for
DOD Award No. N00014-90-C-0003

OSP #18378

Studies of Electrostatic Waves and VLF-Wave Particle Interaction in the
Ionosphere

Principal Investigator - Paul M. Kintner

The ONR contract to Cornell University (N00014-0-C-0003) was awarded to design and construct a high frequency plasma wave instrument for the Swedish spacecraft Freja and to understand the sources and effects of electrostatic waves in the ionosphere.

The HF plasma wave instrument was designed, constructed, and delivered to the Swedish Space Corporation. The instrument was launched on the Freja satellite in October, 1992 and performed nominally. The HF instrument was designed to provide the first electric field waveforms in the frequency range 50 kHz - 47 Hz. Preliminary data reduction shows nearly monochromatic waves with large amplitudes. As of this date the instrument is spreading as designed and is expected to continue operating for the Freja lifetime.

The study of electrostatic waves in the ionosphere covered several scientific themes from spatial irregularities to ion beam generated waves. Much of the study used data from the Viking spacecraft but also included data from some NASA spacecraft. In total this study produced 10 publications in refereed, archived journals, five invited presentations, and 10 contributed presentations. The papers and presentations are listed in the Appendix.

In addition, two graduate students received major funding from this grant. Both students have completed their Ph.D. degrees. One, Wayne Scales, is an assistant professor at Virginia Polytechnic Institute and the other, Jorge Vago, is a postdoctoral associate with the European Space Agency.

REF ID: A6500

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

Appendix

A. Published Work Acknowledging ONR

- Holmgren, G., and P. M. Kintner, Experimental evidence of widespread regions of small scale plasma irregularities in the magnetosphere, *J. Geophys. Res.*, 95, 6015, 1990.
- Scales, W. A., and P. M. Kintner, Artificial ion beam instabilities 1: Linear theory, *J. Geophys. Res.*, 95, 10,623, 1990.
- Scales, W. A., and P. M. Kintner, Artificial ion beam instabilities 2: Simulations, *J. Geophys. Res.*, 95, 10,643, 1990.
- Li, Y. Q., R. H. Holzworth, H. Hu, M. McCarthy, R. D. Massey, J. V. Rodriguez, P. M. Kintner, U. S. Inan, and W. C. Armstrong, Anomalous optical events detected by rocket-borne sensor in the WIPP Campaign, *Geophys. Res.*, 96, 1315, 1991.
- Kintner, P. M., W. Scales, J. Vago, A. Yau, B. Whalen, R. Arnoldy, and T. Moore, Harmonic H⁺ gyrofrequency structures in auroral hiss observed by high altitude auroral sounding rockets, *J. Geophys. Res.*, 96, 9627, 1991.
- Garbe, G. P., R. L. Arnoldy, T. E. Moore, P. M. Kintner, and J. L. Vago, Observations of transverse ion acceleration in the topside auroral ionosphere, *J. Geophys. Res.*, 97, 1257, 1992.
- Arnoldy, R. L., K. A. Lynch, P. M. Kintner, J. Vago, S. Chesney, T. E. Moore, and C. J. Pollock, Bursts of transverse ion acceleration at rocket altitudes, *Geophys. Res. Lett.*, 19(4), 413, 1992.
- Kintner, P. M., J. Vago, S. Chesney, R. L. Arnoldy, K. A. Lynch, C. J. Pollock, and T. E. Moore, Localized lower hybrid acceleration of ionospheric plasma, *Phys. Rev. Lett.*, 68(16), 2448-2451, 1992.
- Kintner, P. M., Plasma waves and transversely accelerated ions in the terrestrial ionosphere, *Phys. Fluids B*, 4(7), 2264, 1992.
- Vago, J. L., P. M. Kintner, S. W. Chesney, R. L. Arnoldy, K. A. Lynch, T. E. Moore, and C. J. Pollock, Transverse ion acceleration by localized lower hybrid waves in the topside auroral ionosphere, *J. Geophys. Res.*, 97(A11), 16,935-16,957, 1992.

B. Invited Papers Acknowledging ONR

Kintner, P. M., Plasma wave processes in the low altitude auroral acceleration zone, Cambridge Workshop in Theoretical Geoplasma Physics, 1989.

Kintner, P. M., Plasma waves and transverse ion acceleration - A tutorial lecture, Cambridge Workshop in Theoretical Geoplasma Physics, 1991.

Kintner, P. M., Plasma waves and transversely accelerated ions in the Terrestrial Ionosphere, APS Division of Plasma Physics Meeting, 1991.

Bostrom, R., G. Holmgren, and P. M. Kintner, Determining electric fields from double density probe measurements of plasma convection, AGU Fall Meeting, 1991.

Kintner, P. M., J. Vago, R. Arnoldy, T. Moore, and C. Pollock, Localized transverse ion acceleration by lower hybrid waves, Chapman Conference on Microscale and Mesoscale Phenomena in Space, 1992.

Kintner, P. M., Transverse ion acceleration in the O+ source region, Spring AGU Meeting, 1992.

C. Contributed Papers Acknowledging ONR

Moore, T. E., D. L. Reasoner, R. L. Arnoldy, and P. M. Kintner, Topside observations of the auroral ionosphere, American Geophysical Union Spring Meeting, 1989.

Pollock, C. J., T. E. Moore, R. L. Arnoldy, L. J. Cahill, and P. M. Kintner, Three-D thermal/super thermal ion composition measurements obtained during the ARCS 4 sounding rocket flight, American Geophysical Union Fall Meeting, 1990.

Vago, J. L., P. M. Kintner, R. Arnoldy, and G. Garbe, ARCS 4: In-situ wave observations at Electron Frequencies Associated with an ion gun active experiment at auroral latitudes, American Geophysical Union Fall Meeting, 1990.

Arnoldy, R. L., K. Lynch, M. Popecki, P. M. Kintner, L. J. Cahill, Jr., T. E. Moore, and C. J. Pollock, ARCS 4 sounding rocket high time resolution auroral electron distribution function measurements, American Geophysical Union Fall Meeting, 1990.

Chesney, S. W., P. M. Kintner, W. W. L. Taylor, and D. D. Sentman, Observations of VLF waves injected into the ionosphere from the WISP I rocket, American Geophysical Union Fall Meeting, 1990.

Garbe, G. B., R. L. Arnoldy, T. E. Moore, P. M. Kintner, and J. Vago, Observations of ion heating in the topside auroral ionosphere, American Geophysical Union Fall Meeting, 1990.

Kintner, P. M., J. L. Vago, W. A. Scales, A. Yau, B. Whalen, R. Arnoldy, and T. Moore, Structured auroral hiss and transverse ion acceleration, American Geophysical Union Fall Meeting, 1990.

Li, Y. Q., R. H. Holzworth, P. M. Kintner and M. C. Kelley, Electric transient waveforms measured over thunderstorms, American Geophysical Union Fall Meeting, 1990.

Lynch, K. A., R. L. Arnoldy, P. M. Kintner, L. J. Cahill, Jr., T. E. Moore, and C. J. Pollock,
Temporal evolution of auroral electron distribution functions from the ARCS 4 sounding
rocket, American Geophysical Union Spring Meeting, 1991.

Moore, T. E., C. J. Pollock, R. L. Arnoldy, L. J. Cahill, Jr., and P. M. Kintner, ARCS 4
experiment: Plasma heating and flow observations, American Geophysical Union Spring
Meeting, 1991.

Kintner, P. M., R. L. Arnoldy, T. Moore, and D. Gurnett, Transverse acceleration of H⁺ by lower
H⁺ Bernstein waves in the high altitude ionosphere, Workshop on Plasma Experiments in the
Laboratory and Space, 1991.